CLAIMS

What is claimed is:

1. A method for finding an optimal unification substitution for formulas in a technology library during integrated circuit design, comprising steps of:

(a) receiving input, said input including a list L of pairs of formulas in standard form, a set S of substitutions for variables, a right part $e(x_1, \ldots, x_p)$ of an identity, and an information $I = \{t, h, r, a, p\}$ on best application;

(b) when said list L is not empty, extracting and removing first pair $(f'(A'_1, \ldots, A'_{n'}), g'(B'_1, \ldots, B'_{m'}))$ from said list L;

(c) removing head inverters and buffers from formulas $f'(A'_1, \ldots, A'_{n'})$ and $g'(B'_1, \ldots, B'_{m'})$ and obtaining a pair $(f(A_1, \ldots, A_n), g(B_1, \ldots, B_m))$;

(d) when said f is a commutative operation but neither a variable nor constant, and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, searching for a basic argument A_j of said formula $f(A_1, \ldots, A_n)$;

(e) when said basic argument A_j is found, letting P be head of said A_j and setting $i = 1$;

(f) when head of B_i is equal to said P, making copy L' of said list L and making copy S' of said set S; and

(g) forming a reduced pair (A', B') for pairs $(f(A_1, \ldots, A_n), f(B_1, \ldots, B_n))$ and (A_j, B_i) and adding said pairs (A_j, B_i) and (A', B') to said list L'.

2. The method of claim 1, further comprising a step of repeating said steps (a) through (g) for said list L', said set S', said formula $e(x_1, \ldots, x_p)$, and said information $I = \{t, h, r, a, p\}$.

3. The method of claim 1, wherein said step (b) further comprising when said list L is empty, making new application and updating said information $I = \{t, h, r, a, p\}$ on best application.

4. The method of claim 1, wherein said step (d) further comprising when said f is a variable and said formula $g(B_1, \ldots, B_m)$ can be substituted for said variable f, setting $s_i = g(B_1, \ldots, B_m)$, and returning to said step (b).

5. The method of claim 1, wherein said step (d) further comprising when said f is constant but not a variable and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, returning to said step (b).

6. The method of claim 1, wherein said step (d) further comprising when said f is a noncommutative operation but neither a variable nor constant and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, adding pairs $(A_1, B_1), \ldots, (A_n, B_n)$ to said list L and returning to said step (b).

7. The method of claim 1, wherein said step (d) further comprising when said f is an aggregative operation but neither a variable nor constant and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, forming decomposed pair, adding said decomposed pair to said list L, and returning to said step (b).

8. The method of claim 1, wherein said step (f) further comprising steps of:

   (f1) when said head of B_i is not equal to said P, setting $i = i + 1$; and

   (f2) when said i is not greater than n, returning to said step (f).

9. An apparatus for finding an optimal unification substitution for formulas in a technology library during integrated circuit design, comprising:

(a) means for receiving input, said input including a list L of pairs of formulas in standard form, a set S of substitutions for variables, a right part $e(x_1, \ldots, x_p)$ of an identity, and an information $I = \{t, h, r, a, p\}$ on best application;

(b) when said list L is not empty, means for extracting and removing first pair $(f'(A'_1, \ldots, A'_{n'}), g'(B'_1, \ldots, B'_{m'}))$ from said list L;

(c) means for removing head inverters and buffers from formulas $f'(A'_1, \ldots, A'_{n'})$ and $g'(B'_1, \ldots, B'_{m'})$ and means for obtaining a pair $(f(A_1, \ldots, A_n), g(B_1, \ldots, B_m))$;

(d) when said f is a commutative operation but neither a variable nor constant, and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, means for searching for a basic argument A_j of said formula $f(A_1, \ldots, A_n)$;

(e) when said basic argument A_j is found, means for letting P be head of said A_j and means for setting $i = 1$;

(f) when head of B_i is equal to said P, means for making copy L' of said list L and means for making copy S' of said set S; and

(g) means for forming a reduced pair (A', B') for pairs $(f(A_1, \ldots, A_n), f(B_1, \ldots, B_n))$ and (A_j, B_i) and means for adding said pairs (A_j, B_i) and (A', B') to said list L'.

10. The apparatus of claim 9, further comprising when said list L is empty, means for making new application and means for updating said information $I = \{t, h, r, a, p\}$ on best application.

11. The apparatus of claim 9, further comprising when said f is a variable and said formula $g(B_1, \ldots, B_m)$ can be substituted for said variable f, means for setting $s_i = g(B_1, \ldots, B_m)$.

12. The apparatus of claim 9, further comprising when said f is a noncommutative operation but neither a variable nor constant and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, means for adding pairs $(A_1, B_1), \ldots, (A_n, B_n)$ to said list L.

13. The apparatus of claim 9, further comprising when said f is an aggregative operation but neither a variable nor constant and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, means for forming decomposed pair and means for adding said decomposed pair to said list L.

14. The apparatus of claim 9, further comprising when said head of B_i is not equal to said P, means for setting $i = i + 1$.

15. A computer-readable medium having computer-executable instructions for performing a method for finding an optimal unification substitution for formulas in a technology library during integrated circuit design, said method comprising steps of:

(a) receiving input, said input including a list L of pairs of formulas in standard form, a set S of substitutions for variables, a right part $e(x_1, \ldots, x_p)$ of an identity, and an information $I = \{t, h, r, a, p\}$ on best application;

(b) when said list L is not empty, extracting and removing first pair $(f'(A'_1, \ldots, A'_{n'}), g'(B'_1, \ldots, B'_{m'}))$ from said list L;

(c) removing head inverters and buffers from formulas $f'(A'_1, \ldots, A'_{n'})$ and $g'(B'_1, \ldots, B'_{m'})$ and obtaining a pair $(f(A_1, \ldots, A_n), g(B_1, \ldots, B_m))$;

(d) when said f is a commutative operation but neither a variable nor constant, and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, searching for a basic argument A_j of said formula $f(A_1, \ldots, A_n)$;

(e) when said basic argument A_j is found, letting P be head of said A_j and setting $i = 1$;

(f) when head of B_i is equal to said P, making copy L' of said list L and making copy S' of said set S; and

(g) forming a reduced pair (A', B') for pairs $(f(A_1, \ldots, A_n), f(B_1, \ldots, B_n))$ and (A_j, B_i) and adding said pairs (A_j, B_i) and (A', B') to said list L'.

16. The computer-readable medium of claim 15, wherein said method further comprising a step of repeating said steps (a) through (g) for said list L', said set S', said formula $e(x_1, \ldots, x_p)$, and said information $I = \{t, h, r, a, p\}$.

17. The computer-readable medium of claim 15, wherein said step (b) further comprising when said list L is empty, making new application and updating said information $I = \{t, h, r, a, p\}$ on best application.

18. The computer-readable medium of claim 15, wherein said step (d) further comprising when said f is a variable and said formula $g(B_1, \ldots, B_m)$ can be substituted for said variable f, setting $s_i = g(B_1, \ldots, B_m)$, and returning to said step (b).

19. The computer-readable medium of claim 15, wherein said step (d) further comprising when said f is constant but not a variable and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, returning to said step (b).

20. The computer-readable medium of claim 15, wherein said step (d) further comprising when said f is a noncommutative operation but neither a variable nor constant and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, adding pairs $(A_1, B_1), \ldots, (A_n, B_n)$ to said list L and returning to said step (b).

21. The computer-readable medium of claim 15, wherein said step (d) further comprising when said f is an aggregative operation but neither a variable nor constant and when heads of said formulas $f(A_1, \ldots, A_n)$ and $g(B_1, \ldots, B_m)$ are equal, forming decomposed pair, adding said decomposed pair to said list L, and returning to said step (b).

22. The computer-readable medium of claim 15, wherein said step (f) further comprising steps of:

(f1) when said head of B_i is not equal to said P, setting $i = i + 1$; and

(f2) when said i is not greater than n, returning to said step (f).